BigBOSS and SNIa Spectroscopic Followup

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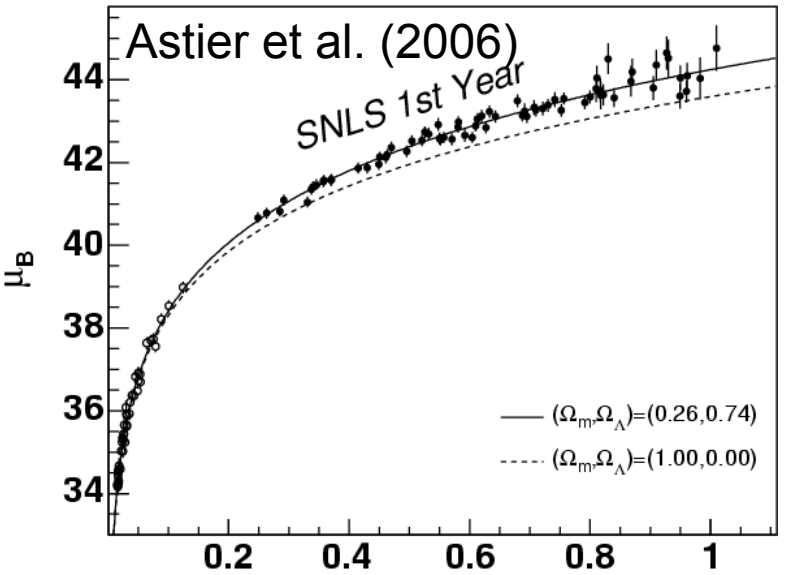
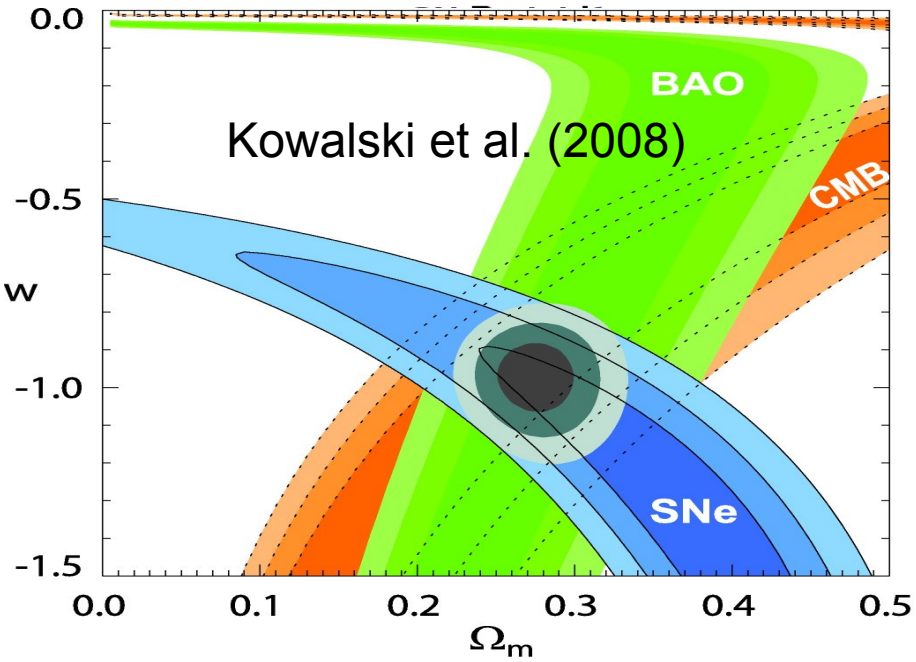
Lest We Forget...

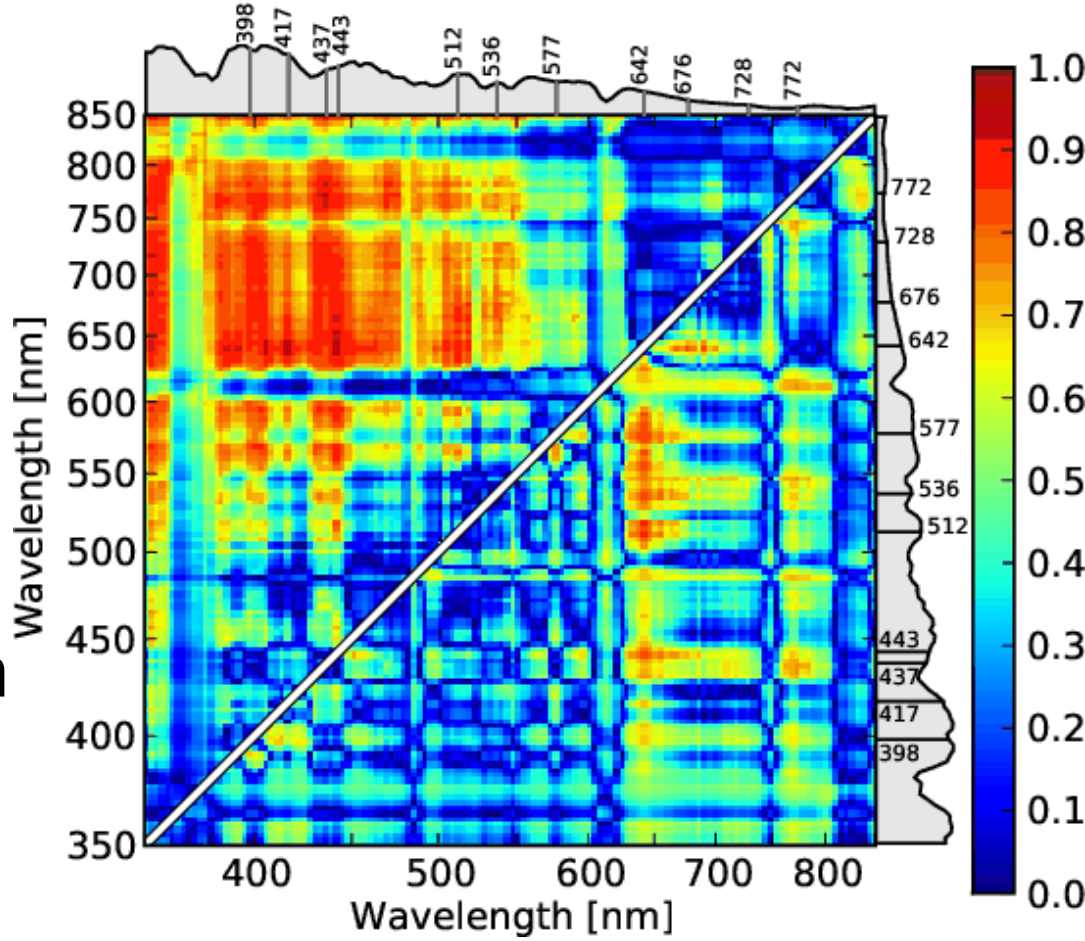
- Accelerated expansion of the universe and dark energy discovered using Type Ia supernovae
- Map expansion history of the universe
  - Brightness gives distance
  - Redshift gives relative size the universe
- Important contributer to dark-energy constraints





Supernova Spectroscopy

- Redshift (galaxy or SN)
- Typing SN Ia
  - SiII feature at 6150Å
  - R~150 S/N~5
- Subclassification within Type Ia
  - Figure shows correlation between spectral flux ratios and absolute magnitude
  - R~150 S/N~25

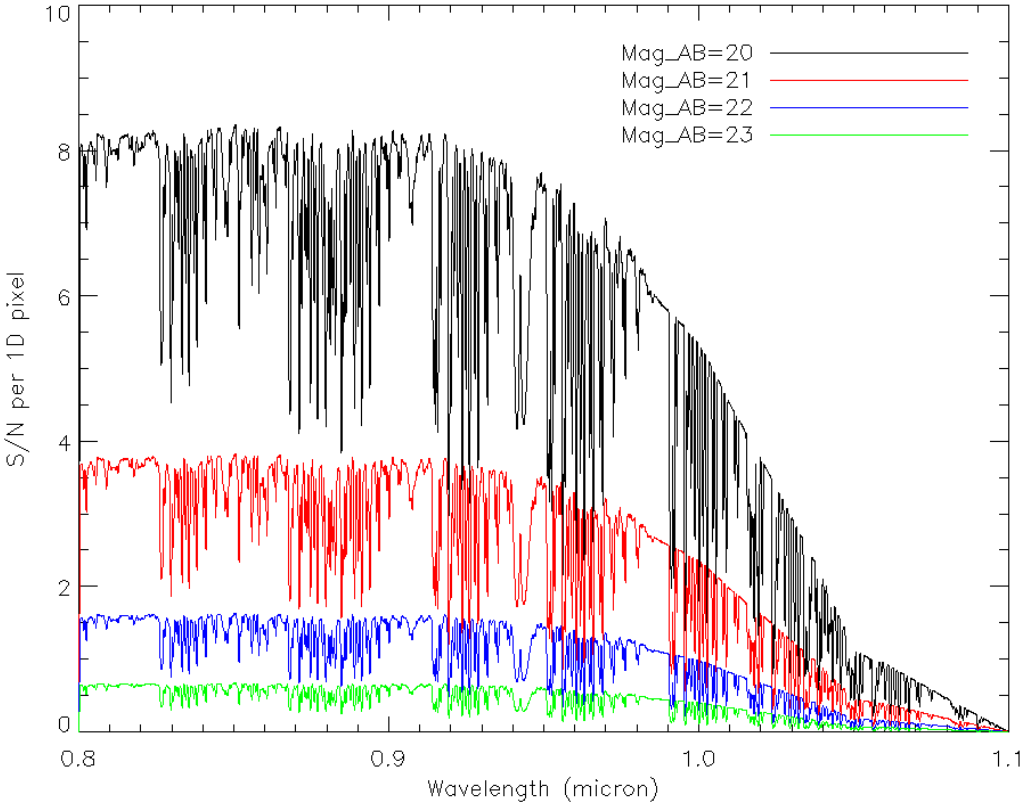


Bailey et al. (2009)

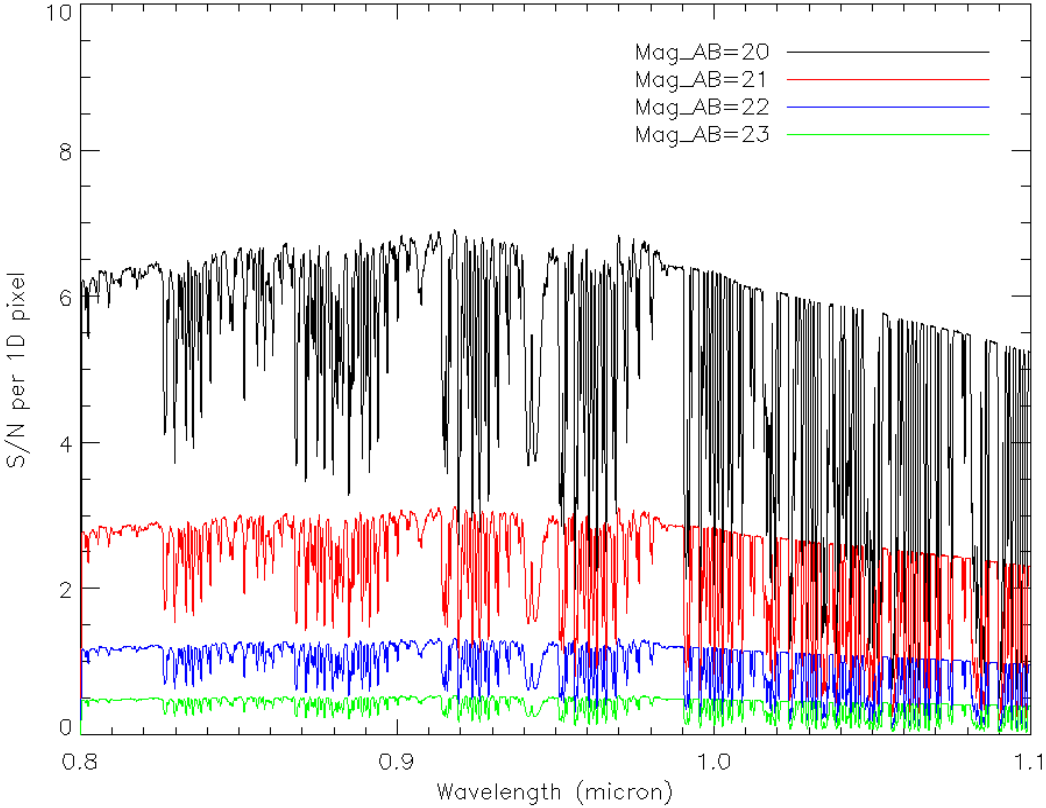
BigBOSS S/N

- Nick Mostek calculated BigBOSS S/N for AB=constant spectra, λ/δλ~13000, 30 min exposure for CCD and HgCdTe

CCD



HgCdTe

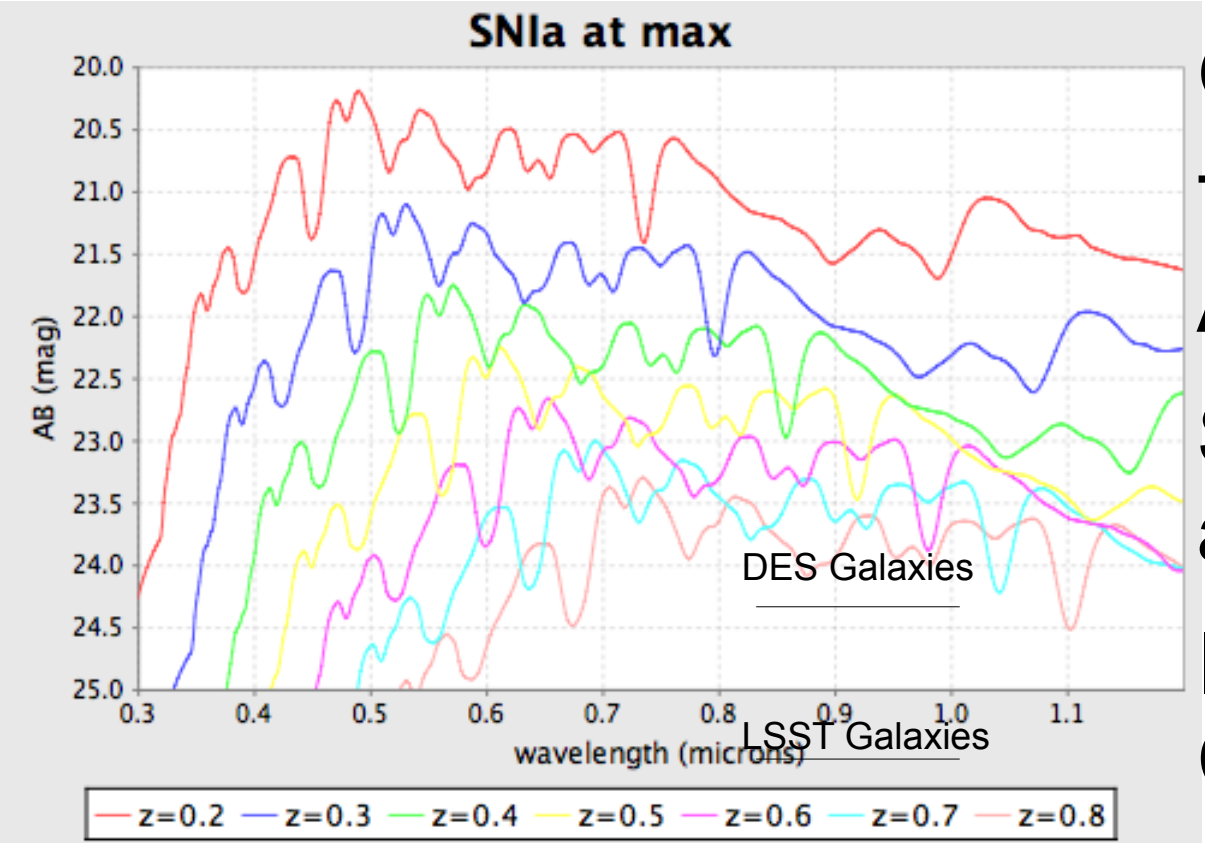


BigBOSS SN S/N

- Translating from λ/δλ~13000 to 150
- Recall
  - Typing S/N~5, Subtyping S/N~25

	CCD		HgCdTe	
AB	S/N R~13000	S/N R~150	S/N R~13000	S/N R~150
20	7.7	71.68	6	55.86
21	3.5	32.58	2.5	23.27
22	1.5	13.96	1	9.31
23	0.5	4.65	0.5	4.65

SN Mag vs BigBOSS Depth



Given BigBOSS depths:

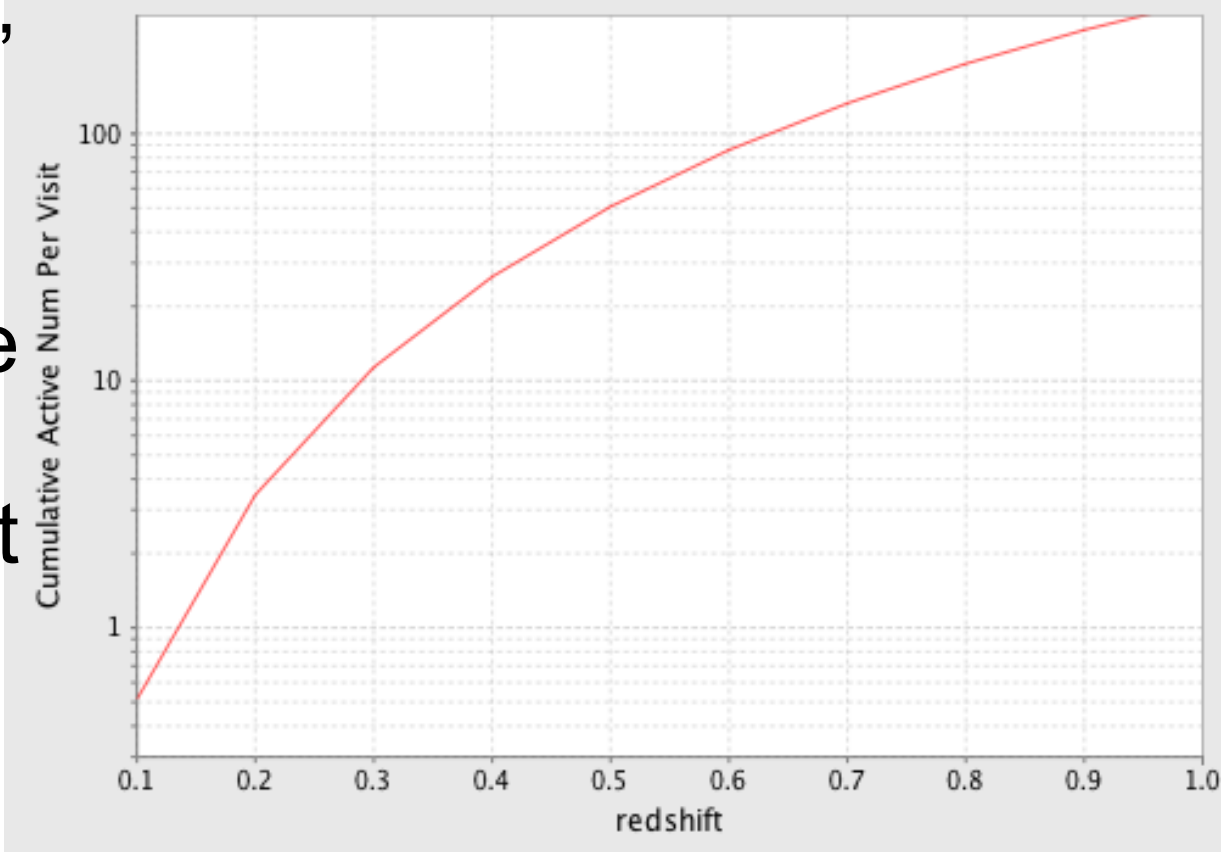
Typing Requirement at AB=23, z~0.4

Subtyping Requirement at AB=21, z~0.25

Important features in CCD wavelengths

Cumulative SN Discovery Rates

- Cumulative number of “active” (2-month rest-frame window around peak) SNe in a single BigBOSS footprint
- ~30 up to z=0.4
- ~8 up to z=0.25
- ~0.01 strongly lensed z>0.4



Within BigBOSS Survey

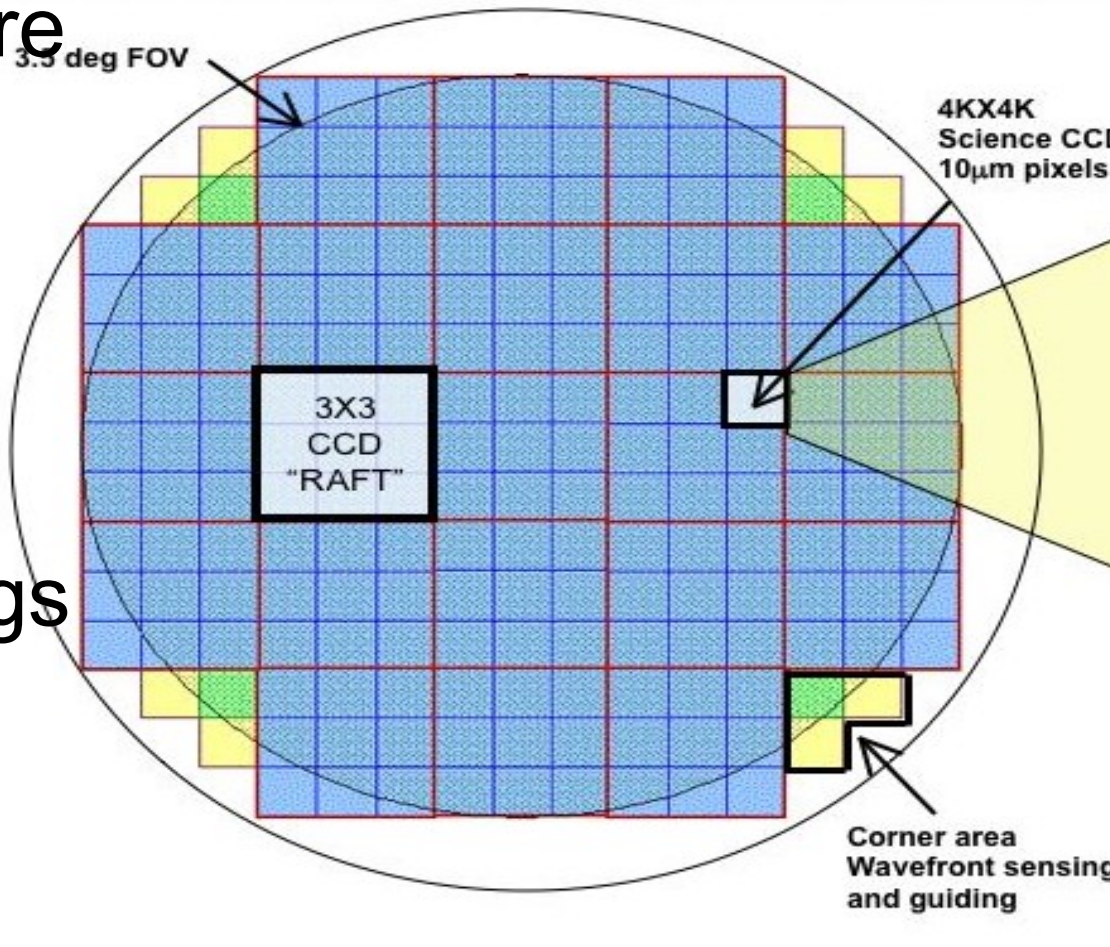
- Coordinated wide-field imaging surveys search fields just before they are observed by BigBOSS
  - Unlike rolling searches that observe fixed areas of sky, there is no automatic building of light curves: photometric follow-up needed elsewhere
  - Provide list of all AB<22.5 transients
  - PanSTARRS?
- BigBOSS sacrifices ~30 fibers for parasitic typing of likely SNe Ia (or even all transients)

Non-Standard BigBOSS Observing

- PanSTARRS/LSST/?? plan high-redshift supernova searches
- Anticipate using BigBOSS spectrograph for deep observation of selected fields for photo-z calibration, cluster galaxy redshifts, ...
- Select the same fields!
  - Spectra of objects with guaranteed photometric light curves
  - Divvy up the many 30 min exposures to either give one epoch depth or spectral time series

Search Imaging

- Survey solid angles are similar
  - BigBOSS: 7 sq deg
  - DES: 3 sq deg
  - LSST: 9.6 sq deg
- Relatively few pointings from any telescope needed to cover a common patch of sky



The “Mundane”

- BigBOSS as a search telescope - Serendipitous SNe in fibers (Madgwick et al. 2003)
  - Trigger photometric follow-up
- A posteriori host-galaxy redshifts and characterization from old surveys
  - Increase SNe in the Hubble diagram and test for correlations in host-galaxy properties
  - “Thousands of Supernovae” SDSS-III project to get host galaxies of ~4000 SDSS-II SNe (PI: B. Nichol)

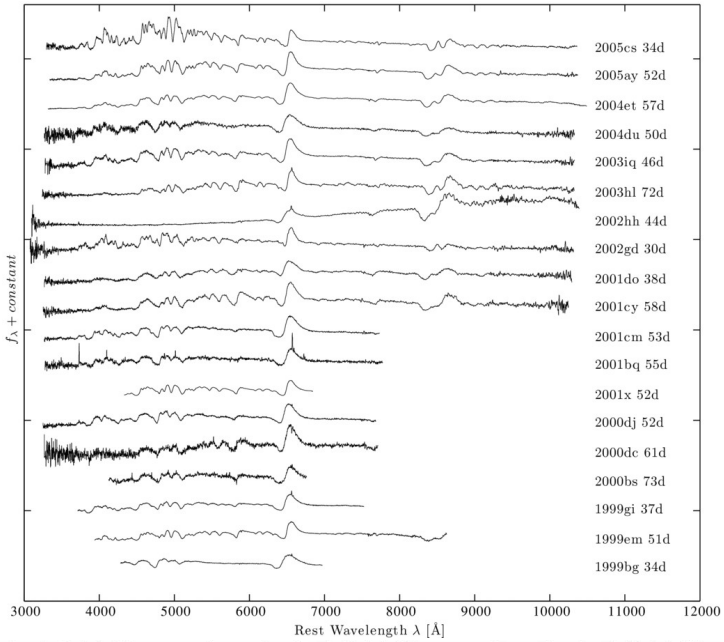
Science

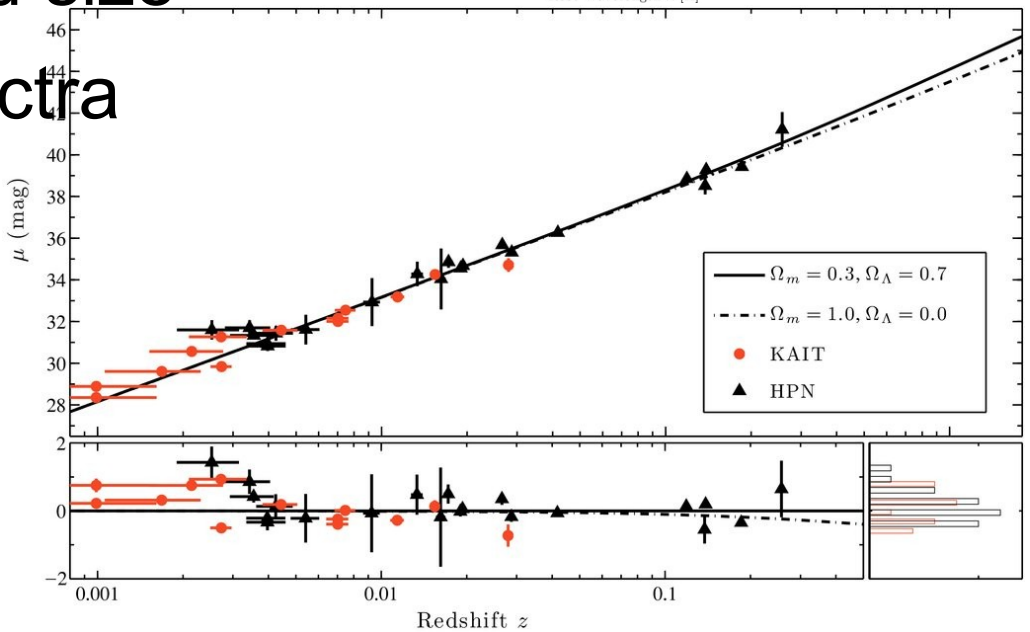
- The focus of SN cosmology will depend on what JDEM is doing and new discoveries SN Ia
  - Improved control of SN systematics redefine the “best” that can be done from the ground
- Spectroscopy resolves typing ambiguity: a source of uncertainty in high-redshift rates
- Anisotropy and inhomogeneity
  - Dark energy clustering, lensing magnification, ...
  - High-z searches have covered small patches of sky
  - Relative brightnesses insensitive to most distance systematics

Type II-P Supernovae

Poznanski et al. (2009)

- Plateau magnitude correlated with Fe velocities at a fixed date after explosion
  - 0.2 mag dispersion
  - Baade-Wesselink: black body of known temperature and size
  - Should work with two spectra on the plateau
- Independent distance indicator, independent systematics





Conclusions

- Under standard observing, BigBOSS can type SNe to z~0.4, subtype to 0.25 (after spectrophotometric normalization)
- Prepend “classic” search of fields shortly before observation by BigBOSS
- Concurrent “rolling” search in deep fields burned in by BigBOSS
- Spectra of (strong lensed) SNe Ia, Type II-P, and other transients broadens scope of BigBOSS

Fact Sheet

	BigBOSS	DES	LSST	
FOV	7	3	9.6	sd
Fibers	4000			
SN # density			4 @ z=0.3	
			15 @ z=0.5	
			50 @ z=0.8	
Galaxy # density		10	40	#/arcmin^2
Galaxy I Mag		<24.3	<25	
Targeted AB Mag	20		21.5 @ z=0,3	
			22.6 @ z=0.5	
			23.7 @ z=0.8	
Req S/N	8 l/dl=4550		5 l/dl=35	
			10 l/dl=590	